Claims

1. A connector having a male plug comprising a male plug shell which is formed in an approximately tube shape and has a steel ball, which is able to rotate and move in radial direction, near its opening part and a female plug comprising a female plug shell which is formed in an approximately tube shape and is connected to said male plug shell and connected to a line which transmits electric power, electric signal, and optical signal comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around the opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction; and

an approximately tube slide cover which comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis,

wherein a first projection part which engages said slide sleeve and a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell,

said slide cover comprises a second projection part in

order to constrain relative rotation of said slide cover and said female plug shell around the central axis,

said slide cover can slide to said female plug shell by caulking an approximately ring shape end part of its bottom part placed at the opposite side of its opening part inward, and

said slide sleeve engages said first projection part comprised in said female plug shell, said slide sleeve comprises a first concave part which guides said first projection part so that it can slide in the central axis direction and a second concave part which guides said second projection part so that it can slide in the central axis direction.

2. A connector according to claim 1, wherein said slide sleeve is formed in an approximately ring shape which comprises a large ring part of an approximately band shape and a small ring part of an approximately band shape having relatively smaller aperture and sharing the axis with said large ring part,

wherein said slide sleeve is formed to have two-step ring structure whose cross-section vertical to the axis direction is approximately two steps, said first concave part is formed at said small ring part side of said slide sleeve so that its opening part faces the bottom of said slide sleeve, and

said second concave part is formed at said large ring

part side of said slide sleeve so that its opening part faces said opening part of said slide cover.

3. A female plug which comprises an approximately tube female plug shell connected to an approximately tube male plug shell, which has a rotatable steel ball which is installed around the opening part and can be shifted in the radial direction, comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around said opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction; and

an approximately tube slide cover which comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along said central axis,

wherein a first projection part which engages to said slide sleeve and a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell,

said slide cover comprises a second projection part in order to constrain relative rotation of said slide cover and said female plug shell around the central axis,

said slide cover can slide to said female plug shell by caulking an approximately ring shape end part of its bottom part placed at the opposite side of its opening part inward, and

said slide sleeve engages to said first projection part comprises in said female plug shell, said slide sleeve comprises a first concave part which guides said first projection part so that it can slide in the central axis direction and a second concave part which guides the second projection part so that it can slide in the central axis direction.

4. A female plug according to claim 3, wherein said slide sleeve is formed in an approximately ring shape which comprises a large ring part of an approximately band shape and a small ring part of an approximately band shape having relatively smaller aperture and sharing the axis with said large ring part,

wherein said slide sleeve is formed to have two-step ring structure whose cross-section vertical to the axis direction is approximately two steps,

said first concave part is formed at said small ring part side of said slide sleeve so that its opening part faces said bottom of said slide sleeve, and

said second concave part is formed at said large ring part side of said slide sleeve so that its opening part faces the opening part of said slide cover.

5. A connector having a male plug comprising a male plug shell which is formed in an approximately tube shape and has a steel ball, which is able to rotate and move in radial direction, near its opening part and a female plug comprising a female plug shell which is formed in an approximately tube shape and is connected to said male plug shell and connected to a line which transmits electric power, electric signal, and optical signal comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around the opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction; and

an approximately tube slide cover which can be slide to said female plug shell, comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis,

wherein said plug shell comprises a first projection part which engages said slide sleeve and a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell,

said slide cover comprises a second projection part in order to constrain relative rotation of said slide cover and said female plug shell around the central axis, and

said slide sleeve comprises a first a first concave part which guides said first projection part so that it can slide in the central axis direction and a second concave part which guides said second projection part so that it can slide in the central axis direction.

6. A connector according to claim 5, wherein said slide sleeve is formed in an approximately ring shape which comprises a large ring part of an approximately band shape and a small ring part of an approximately band shape having relatively smaller aperture and sharing the axis with said large ring part,

wherein said slide sleeve is formed to have two-step ring structure whose cross-section vertical to the axis direction is approximately two steps, said first concave part is formed at said small ring part side of said slide sleeve so that its opening part faces the bottom of said slide sleeve, and

said second concave part is formed at said large ring part side of said slide sleeve so that its opening part faces said opening part of said slide cover.

7. A female plug which comprises an approximately tube female plug shell connected to an approximately tube male

plug shell, which has a rotatable steel ball which is installed around the opening part and can be shifted in the radial direction, comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around said opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction; and

an approximately tube slide cover which can be slide to said female plug shell, comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis,

wherein a first projection part which engages said slide sleeve and a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell,

said slide cover comprises a second projection part in order to constrain relative rotation of said slide cover and said female plug shell around the central axis, and

said slide sleeve engages said first projection part comprises in said female plug shell, said slide sleeve comprises a first concave part which guides said first projection part so that it can slide in the central axis

direction and a second concave part which guides the second projection part so that it can slide in the central axis direction.

8. A female plug according to claim 7, wherein said slide sleeve is formed in an approximately ring shape which comprises a large ring part of an approximately band shape and a small ring part of an approximately band shape having relatively smaller aperture and sharing the axis with said large ring part,

wherein said slide sleeve is formed to have two-step ring structure whose cross-section vertical to the axis direction is approximately two steps, said first concave part is formed at said small ring part side of said slide sleeve so that its opening part faces the bottom of said slide sleeve, and

said second concave part is formed at said large ring part side of said slide sleeve so that its opening part faces said opening part of said slide cover.

9. A connector having a male plug comprising a male plug shell which is formed in an approximately tube shape and has a steel ball, which is able to rotate and move in radial direction, near its opening part and a female plug comprising a female plug shell which is formed in an approximately tube shape and is connected to said male plug shell and connected to a line which transmits electric power, electric signal,

and optical signal comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around the opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction; and

an approximately tube slide cover which comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis,

wherein a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell, and

said slide cover can slide to said female plug shell by caulking an approximately ring shape end part of its bottom part placed at the opposite side of its opening part inward.

10. A connector according to claim 9, wherein each of said approximately tube shape represents an approximately cylindrical shape.

11. A connector according to claim 10, wherein said slide cover comprises a second projection part in order to constrain relative rotation of said slide cover and said

female plug shell around the central axis.

12. A connector according to claim 11, wherein said female plug shell comprises a second concave part which guides said second projection part so that it can slide in the central axis direction.

13. A connector according to claim 9, wherein each tube component has a sectional shape vertical to the central axis formed in a plane approximately similar to each other and that the plane is always asymmetric to rotation in an arbitrary angle θ ($\forall\theta \neq 2m\pi$; m is an arbitrary integer number) around an arbitrary point in its perimeter.

14. A connector having a female plug comprising a female plug shell which is formed in an approximately tube shape and is connected to a male plug comprising a male plug shell which is formed in an approximately tube shape and has a steel ball, which is able to rotate and move in radial direction, near its opening part, comprising:

an approximately tube slide sleeve which presses a rotatable steel ball installed around the opening part of said male plug shell from a periphery of said opening part to the centripetal direction;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction;

and

an approximately tube slide cover which comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis,

wherein a contacting part to which said steel ball can contact while said slide sleeve is pressing said steel ball to said centripetal direction are formed on the surface of the side wall of said female plug shell, and

said slide cover can slide to said female plug shell by caulking an approximately ring shape end part of its bottom part placed at the opposite side of its opening part inward.

15. A female plug according to claim 14, wherein each of said approximately tube shape represents an approximately cylindrical shape.

16. A female plug according to claim 15, wherein said slide cover comprises a second projection part in order to constrain relative rotation of said slide cover and said female plug shell around the central axis.

17. A connector according to claim 16, wherein said female plug shell comprises a second concave part which guides said second projection part so that it can slide in the central axis direction.

18. A connector according to claim 14, wherein each tube

component has a sectional shape vertical to the central axis formed in a plane approximately similar to each other and that the plane is always asymmetric to rotation in an arbitrary angle θ ($\forall\theta \neq 2m\pi$; m is an arbitrary integer number) around an arbitrary point in its perimeter.

19. A female plug of an optical connector comprising an adaptor unit being able to be attached or detached having a holding member which holds the facet of the pointed end of the ferrule to contact, comprising:

an approximately tube female plug shell holding said adaptor unit inside;

an approximately tube slide sleeve which presses a rotatable steel ball installed around the opening part of a male plug shell from a periphery of said opening part to the centripetal direction and is slidably disposed around said female plug shell;

a spring which presses back said slide sleeve along the central axis of said female plug shell until said slide sleeve presses said steel ball to said centripetal direction;

an approximately tube slide cover which comprises a slide sleeve and slides said slide sleeve against elastic force of said spring along the central axis; and

a bayonet lock structure which enables said adaptor unit to be attached or detached to said female plug shell.

20. A female plug of an optical connector according to

claim 19, wherein an approximately tube shape female plug shell is formed including said female plug.

21. A female plug of an optical connector according to claim 19 or 20, wherein said adaptor unit comprises a shaft which conveys rotational operation to lock and unlock said bayonet lock.

22. A female plug of an optical connector according to claim 21, comprising a hook bolt at said female plug from which said adaptor unit is separated, wherein said hook bolt comprises a bayonet lock groove which sufficiently engages the end part A of said adaptor shaft formed at the opposite side to said male plug.

23. A female plug of an optical connector according to claim 22, wherein two convex parts each of which is approximately orthogonal to said shaft are formed at said end part A, and at least one portion of said engaging groove which is to be engaged to a flathead screwdriver is formed at said hook bolt by using a portion of said bayonet lock groove.

24. A female plug of an optical connector according to any one of claims 21-23, wherein an end part B, which is placed at said male plug side of said shaft, is arranged at approximately center of the end portion of said female plug.

25. A female plug of an optical connector according to any one of claims 21-24, comprising a spring which extends when unlocking said bayonet lock and presses forward said end part B placed at said male plug side of said shaft to the approximately end part of said female plug,

wherein said adaptor unit is separated from said female plug by further pulling said end part B which is pressed by said spring to the same direction, or the forward direction of the end part of said female plug.

26. A female plug of an optical connector according to any one of claims 21-25, wherein a fingertip operation part which is formed around said end portion B arranged at said male plug side of said shaft is formed in order to lock and unlock said bayonet lock or to pull out said adaptor unit.

27. A female plug of an optical connector according to claim 26 or 27, wherein said fingertip operation part comprises an o-ring, a cap, and a knob made of materials such as rubber and resin.

28. A female plug of an optical connector according to claim 26 or 27, wherein said fingertip operation part comprises an approximately butterfly-like head which makes it possible or easier to screw or loose only by using finger tips.

29. A female plug of an optical connector according to any one of claims 19-28, wherein said bayonet lock groove which is to be formed at the female side of said bayonet lock structure comprises:

a first guide groove which guides the convex part placed at the male side of said bayonet lock in the central axis direction along the detaching direction, and

a second guide groove which guides said convex part at the male side to the central axis rotational direction,

wherein an approximately cylindrical round groove, at which the central axis is approximately orthogonal to the axis, is formed at the end part of said second guide groove.

30. A female plug of an optical connector according to any one of claims 19-29, wherein said slide cover can slide to said female plug shell by caulking an approximately ring shape end part of its bottom part placed at the opposite side of its opening part inward.

31. A female plug of an optical connector comprising a holding member which holds the facet of the pointed end of the ferrule to contact, wherein said adaptor unit has a bayonet lock structure which enables said adaptor unit to be attached or detached.

32. A female plug of an optical connector according to claim 31, wherein an approximately tube shape female plug

shell is formed including said female plug.

33. A female plug of an optical connector according to claim 31 or 32, wherein said adaptor unit comprises a shaft which conveys rotational operation to lock and unlock said bayonet lock.

34. A female plug of an optical connector according to claim 33, comprising a hook bolt at said female plug from which said adaptor unit is separated, wherein said hook bolt comprises a bayonet lock groove which sufficiently engages the end part A of said adaptor shaft formed at the opposite side to said male plug.

35. A female plug of an optical connector according to claim 34, wherein two convex parts each of which is approximately orthogonal to said shaft are formed at said end part A, and at least one portion of said engaging groove which is to be engaged to a flathead screwdriver is formed at said hook bolt by using a portion of said bayonet lock groove.

36. A female plug of an optical connector according to any one of claims 33-35, wherein an end part B, which is placed at said male plug side of said shaft, is arranged at approximately center of the end portion of said female plug.

37. A female plug of an optical connector according to

any one of claims 33-36, comprising a spring which extends when unlocking said bayonet lock and presses forward said end part B placed at said male plug side of said shaft to the approximately end part of said female plug,

wherein said adaptor unit is separated from said female plug by further pulling said end part B which is pressed by said spring to the same direction, or the forward direction of the end part of said female plug.

38. A female plug of an optical connector according to any one of claims 33-37, wherein a fingertip operation part which is formed around said end portion B arranged at said male plug side of said shaft is formed in order to lock and unlock said bayonet lock or to pull out said adaptor unit.

39. A female plug of an optical connector according to claim 38, wherein said fingertip operation part comprises an o-ring, a cap, and a knob made of materials such as rubber and resin.

40. A female plug of an optical connector according to claim 38 or 39, wherein said fingertip operation part comprises an approximately butterfly-like head which makes it possible or easier to screw or loose only by using finger tips.

41. A female plug of an optical connector according to

any one of claims 31-40, wherein said bayonet lock groove which is to be formed at the female side of said bayonet lock structure comprises:

a first guide groove which guides the convex part placed at the male side of said bayonet lock in the central axis direction along the detaching direction, and

a second guide groove which guides said convex part at the male side to the central axis rotational direction,

wherein an approximately cylindrical round groove, at which the central axis is approximately orthogonal to the axis, is formed at the end part of said second guide groove.